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(54) An automatic clutch control device with fluid volume compensation means

(57) An automatic clutch control device comprises an electric motor 10 connected via an output shaft 12 and a gearbox 14 having a crank 20 to a piston rod 24 of a master cylinder 30. Slave cylinder 60 is connected by a hose 50 to the master cylinder 30 so that when piston 38 is moved by the motor 10 a piston 62 in the slave cylinder 60 is displaced and operates a clutch. In order to detect a position of the piston 38 a sensor 70 is provided on the piston rod 24 and is connected to a control device 72. Chamber B of the cylinder 30, the hose 50 and a pressure chamber of slave cylinder 60 form a system section which is provided with a snifting bore 80 connected to a compensating container 86. In order to keep the volume constant, eg if the temperature increases, a snifting cycle is initiated which connects/disconnects the snifting bore 80 to the system section.

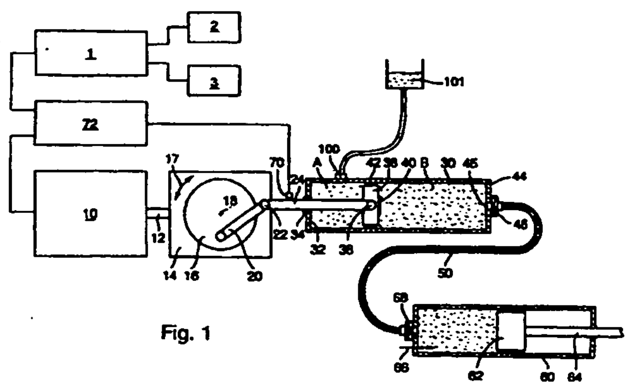
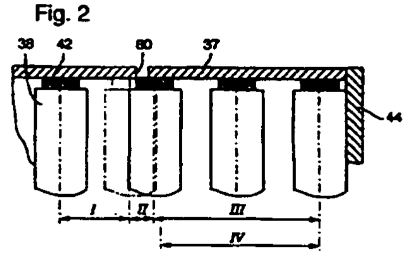


Fig. 1

Fig. 2



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Motor vehicle and method for operating same

The present invention relates to a motor vehicle and a method for operating same, and more particularly to a motor vehicle whose drive device has at least one kinetic device operated by a fluid and connected by a connecting device to a pressure generating device which produces the fluid pressure for operating this kinetic device.

By the term motor vehicles are meant here all single-track and twin-track motor-operated road vehicles, thus more particularly passenger vehicles, small goods vehicles, lorries, special vehicles and motor cycles. The invention is particularly to be used with passenger vehicles and small goods vehicles with passenger vehicle type design.

The drive device of a motor vehicle usually consists of the actual drive motor, preferably an Otto cycle engine or a diesel engine, a clutch device connected to the output shaft of this engine, usually a crank shaft, a gearbox on the output side of the clutch device, and if more than one driven wheel is provided, a compensating gear which distributes the torque and rotary movement to the driven wheels.

When designing the drive devices of motor vehicles a number of targets must be met which partly contradict each other. Thus a modern vehicle must on the one hand offer the user a high degree of comfort and good to very good drive performances whilst on the other hand the consumption, exhaust gas emissions and the danger of breakdown of one component part should be as low as possible. In order to meet these requirements it is necessary to control automatically more and more parts of the drive unit in order to relieve the user on the one hand and to reach the optimum possible operating state of the drive device on the other

hand.

The problems arising here will now be described below more particularly with reference to the operation of a clutch device. It should however be pointed out that this in no way restricts the use of the present invention.

Most motor vehicles supplied in Europe are supplied with a classic shift transmission which has four or five forward gears, a neutral position (idling position) and a reverse gear. Between the engine and gearbox is a clutch, as a rule a single disc dry clutch which has a friction element which when the clutch is closed is pressed by springs with a sufficiently high force onto corresponding friction faces in order to be able to transfer through the thereby arising friction force the torque of the engine reliably to the gearbox. The clutch is brought out of engagement by a disengagement lever for example when changing gear against spring tension so that the gearbox and engine can rotate at different speeds.

The use of the clutch is relatively onerous for the user. The correct function requires the clutch pedal to be pressed down each time up to a stop which even with corresponding hydraulic assistance requires a certain amount of force and is frequently found troublesome particularly in town driving.

In order to relieve the driver of operating the clutch an automatic clutch would be desirable. The automatic clutches offered earlier on the market have however not been generally accepted on account of numerous technical problems.

The alternative is to use an automatic gearbox which instead of a dry clutch has a hydrodynamic converter. However

through the inertia of the converter and through the loss of power arising in the converter the use of an automatic gearbox reduces the acceleration power of the vehicle and further leads in most cases to an increase in fuel consumption.

Of special advantage therefore was an automatic clutch which works faster and more accurately than a hydrodynamic converter and which could be combined with a conventional gearbox without hydrodynamic converter. A requirement for the use of such automatic clutches is however that the clutch can be operated accurately and quickly. The systems and methods known today for hydraulic clutch operations do not however meet the requirement regarding precision.

The object of the present invention is therefore to provide a motor vehicle and method for its operation wherein at least one kinetic device operated by fluid pressure is provided which can be controlled with high precision.

This is achieved according to the invention through a method according to claim 1.

The motor vehicle according to the invention is the subject of claim 100.

Preferred developments of the invention are the subject of the sub-claims.

The precise control of hydraulically operated kinetic devices, that is devices in which the fluid pressure is converted into a movement of a function element is very difficult in a motor vehicle. A hydraulic system has a number of component parts which are each liable to a predetermined manufacturing tolerance. A reduction of these tolerances for increasing the precision of the individual

component parts leads to a non-acceptable increased expense and thus to non-viable extra costs in production.

In addition a hydraulic system in the motor vehicle is subjected to considerable temperature changes. Thus the system must function with precision at outside temperatures in the range from -40 to + 50°C. The hydraulic fluid normally used, mostly a fluid with the chemical and physical properties of a brake fluid, changes the volume with the temperature so that a change of ambient temperature causes considerable volume changes in the hydraulic fluid. The problems with a temperature change are intensified when operating the vehicle since then depending on the assembly and operating mode (town driving, fast cross-country driving) the temperatures can increase well above 100°C.

A further problem is the formation of gas bubbles, more particularly air bubbles in the fluid. The ability of the fluids to dissolve gases likewise depends substantially on the temperature and fluid pressure. A temperature change therefore changes the amount of gas bubbles present in the fluid. Likewise air for example can penetrate into the system from outside.

Since gases are compressible the volume of the fluid is not only temperature but also pressure dependent on the appearance of gas bubbles which makes a precise control considerably difficult.

The present invention further relates to applications DE 195 04 847, DE 195 48 799 and DE 196 02 006 whose contents belong expressly to the disclosure of the present invention.

To solve the problems which are arising the present invention proposes to keep constant the amount of fluid, and more particularly the fluid volume in a system section which

contains preferably at least one pressure generating device, at least one connecting device and at least one kinetic device. The term amount is thereby dependent on the property of the fluid. If the fluid is a liquid then the amount to be kept constant is the liquid volume.

If the fluid is gaseous or has considerable gas constituents then the corresponding properties, thus in particular the compressibility, have to be taken into consideration in order to define the term amount more correctly.

The problems described above are reliably avoided through the method procedure according to the invention. Since according to the invention the liquid volume located in the system section is kept constant, the influence of the tolerances conditioned by manufacture is completely eliminated. By keeping the fluid volume constant the influence of the temperature on the system is furthermore also practically completely removed. If the temperature increases and the fluid expands then the volume becomes corrected accordingly so that always the same volume amount is present in the system section. The same applies accordingly with a volume reduction in the fluid through a reduction in the temperature. It is thus possible to carry out a precise control of the kinetic device which is independent of the fluid volume.

Since the solution according to the invention requires no increased expense for reducing the manufacturing tolerances, it is possible through the invention to control devices of the motor vehicle and more particularly devices of the drive unit by means of a kinetic device very precisely without this higher precision leading to significantly increased building costs.

The pressure generating device used according to the

invention can be a hydrodynamically operating pressure generating device, but particularly preferred is a hydrostatic pressure generation owing to the higher precision. In order to produce the hydrostatic pressure, devices are used which operate on the principle of displacement. These include screw spindles, rotary pistons, ie pistons which are moved substantially rotating within a substantially cylindrical chamber, pistons operating on the principle of a flywheel pump, etc. However particularly preferred is a hydrostatic pressure generation wherein a substantially linear running relative movement is completed between a displacement element and a chamber, and more particularly pressure generation by means of a piston which is moved in a cylinder.

The pressure generating device can be provided so that the displacement element or piston respectively moves between two extreme positions, ie a lower and upper dead point. Particularly preferred however is a design wherein the displacement element or piston respectively can occupy a number of controllable positions in the cylinder. To this end a pressure generating control device is provided which preferably operates within a regulating circuit. This means that the pressure generating control device receives the output signals of a sensor device immediately or after a preceding processing step and takes this sensor signal into consideration during processing.

The sensor device is connected for this purpose to an element which in turn is in active connection with the displacement element or piston respectively.

In order to control the displacement element or piston respectively a motion device is preferably used which produces a movement which moves the displacement element. The motion device can in turn operate on the hydraulic

principle, ie convert a fluid pressure into a movement, preferably a translatory movement which can take place for example through a piston-cylinder unit wherein the piston is biased with fluid on both sides by correspondingly controlled valves.

Particularly preferred however is electrical energy converted in the motion device into motion energy, namely preferably in the form of a linear motor, step motor or preferably a conventional electric motor.

If a translatory movement is required for pressure generation, then the movement of the electric motor is preferably converted by a corresponding crank drive, where applicable by shifting a gearbox into a translatory movement.

The sensor device preferably has at least one inductive capacitive or electro optical sensor which detects the displacement along a path or change of rotary angle. The sensor device can operate on the analogue principle, ie that a voltage, current or frequency change caused by a change of inductance or capacitance or resistance is detected. The sensor device can however also issue directly digital signals in that the movement is detected stepwise and a corresponding signal is issued from the sensor always after exceeding a step limit and this signal is then counted by a numerator.

In the kinetic device the fluid pressure is used for producing a force and movement resulting therefrom. The kinetic device has a function element. If the conversion of the fluid pressure into kinetic energy takes place hydrodynamically this function element can be formed for example in the manner of a bucket wheel or the like. However with this device a hydrostatic energy conversion is

preferred wherein preferably a displacement action is likewise used. Also here displacement elements can be provided, such as rotary pistons and the like wherein the fluid pressure leads to a change in the rotary angle. However particularly preferred is also in this case a translatory relative movement between a chamber and displacement element for converting energy. Particularly preferred as a function element is a piston which is moved in a cylinder.

The displacement element can be formed so that it is moved between two extreme positions without individual intermediate positions being able to be controlled. However particularly preferred is the design where the displacement element can occupy a number of intermediate positions in steps or infinite sequence.

The connecting device causes a flow connection between the pressure generating device and the kinetic device. Preferred is a hose connection. This has the advantage of easier assembly and the further advantage that vibrations are not transferred in the same way as with a pipe connection which can likewise be used. Although through the teaching according to the invention volume changes of the hose can be compensated, preferably a stiff hose is used. This means that the volume change lies with a predetermined pressure change, for example with a pressure change at 10 bar below a predetermined boundary limit.

Keeping the fluid amount or fluid volume constant is preferably carried out by a fluid compensating device. This can be a pressurised supply container for fluid. Furthermore the compensating container can be a fluid container standing under ambient temperature which under certain conditions is brought through a flow connection with this system section wherein the system section comprises the

pressure generating device, connecting device and kinetic device.

The volume compensation is carried out preferably by bringing a pressure generating device and kinetic device into a defined position and then compensating an excess or deficit in the volume by this compensating device. For this purpose a flow connection is opened to the compensating device in this defined position.

It is particularly preferred if the position in which the movable elements of the pressure generating device and kinetic device are with balanced volume is selected so that a system pressure is reached at a predetermined level. The system is preferably located when balanced substantially in the pressureless state, ie that the system pressure corresponds substantially to the ambient temperature. Particularly in this case a fluid supply container of the compensating device is mounted in the vehicle so that the potential difference of the fluid in the compensating container is higher than that in the system section. This is reached in that the compensating container is mounted at a certain height difference from the remaining component parts of the system section.

The flow connection between the compensating device and system section can be made at any point of the system section, ie in the pressure generating device, in the connecting device and in the kinetic device. In order to produce and stop the flow connection with the compensating device a valve can be used which is opened and closed by a suitable device. This is preferably an electrically switched valve which is controlled by signals of a control device, preferably the pressure generating control device.

The flow connection is preferably made however so that an

additional valve is not required. For this for example in the case of a design by means of piston and cylinder in the pressure generating device or kinetic device an opening is provided which is closed and opened by an element which is moved together with the piston. Closing and opening of the flow connection is preferably carried out by the piston itself.

The opening can be arranged for example as a ring groove in one of the cylinders. Since the volume compensation as a rule however only requires a small flow cross-section of the flow connection it is sufficient as a rule to provide a corresponding bore in the cylinder wall.

The piston, preferably this is the piston of the pressure generating device, can then be moved into a position in which the opening is opened and a flow connection is provided between the compensating device, cylinder connection device and kinetic device and into a position or position area in which this connection is not provided.

The piston is then brought in fixed or variable time intervals into the position in which this flow connection is open wherein then the volume compensation is carried out. The piston is then moved into a position in which the flow connection is interrupted so that a corresponding pressure build up in the system section can take place.

The opening or bore which is in flow connection with the fluid compensating container is termed snifting opening or snifting bore, and the process of bringing the movable elements or valves into a position in which the snifting opening is in flow connection with the system section is termed snifting cycle.

The snifting cycle can be repeated in fixed time intervals

or in time intervals which are dependent on the operating conditions of the vehicle, wherein particular consideration can be given here to the actual operating values of the engine, such as torque, speed and more particularly also temperature characteristic values such as engine oil temperature, coolant temperature, ambient temperature, gearbox oil temperature etc.

The snifting cycle is preferably repeated at short time intervals of some few minutes or even shorter in order to obtain the desired constancy of the fluid volume.

Through the high volume constancy which is achieved it is possible to use the teaching according to the invention in connection with a number of devices of the motor vehicle and more particularly the drive device thereof.

As already explained a preferred design is to use a piston-cylinder unit controlled by a control device as master cylinder and a kinetic device, likewise formed as a piston-cylinder unit, which then forms a slave cylinder. If the master cylinder as mentioned is operated by a motion device, controlled by the control device taking into account the signals of the sensor device, the position of the master cylinder and thus also the position of the slave cylinder can be set with high precision.

The teaching of the present invention can be applied in a motor vehicle and more particularly in the drive device of a motor vehicle everywhere where the precise kinetic control of an element is of importance.

With a continuously variable transmission as a rule at least one element is provided where its change in position also involves a change in the translation of the gearing. With a cone pulley gearbox this is for example the position of a

cone pulley. With the teaching of the invention the position of the cone pulley can be controlled very accurately so that changes in position as a result of temperature changes of the hydraulic fluid do not affect the position and thus translation ratio.

The invention can be used with particular advantage with devices where the change in position of an element is connected with a change in a force which is applied to a component part. With hydraulically operated devices in motor vehicles, such as for example with hydraulically assisted clutches, the control is carried out as a rule until the function element, thus for example the piston in the slave cylinder, occupies its position substantially between two extreme positions, eg "clutch opened" - "clutch closed". Intermediate positions ie slipping of the clutch is caused by the driver himself by depressing the clutch pedal to a correspondingly greater or lesser degree.

Through the teaching of the invention it is possible to control quite precisely not only the position of the function element, eg in the slave cylinder, but through an elastic device interacting therewith with predetermined characteristic also the force applied on a component part.

The invention can therefore be used generally everywhere where a precise force application is required. A precise force application makes it possible to turn two component parts with a substantially predetermined friction characteristic against each other with defined slip. This can be used for example in automatic transmissions where today normally only the complete braking or release of a friction element is provided.

Furthermore a use is also of advantage where a differential speed is to be restricted between two component parts. This

is for example the case with compensating gears such as are used as axial differential and central differential in the case of single axle and twin-axle drive. Through the use of the invention it is possible to use with a corresponding friction element an infinitely variable locking differential action in the case of such compensating gearing.

A particularly preferred use of the invention is as explained the clutch device of a vehicle and more particularly the control of a shiftable clutch and more particularly the control of a substantially conventional clutch, such as a single-disc dry clutch.

The comfort which can be achieved by an automatic clutch is only then accepted by the driver if the clutch operation is carried out before and after the shift process with the highest possible speed. This requires short disengagement and re-engagement times of the clutch.

By applying the teaching of the invention the control of the clutch can be carried out so that the clutch is only engaged each time so far as is necessary to transfer the torque transferred each time by the clutch. If for example a torque of 70 Nm has to be transferred in the actual operating state then the clutch is closed so far that it can transfer 80 Nm. The path for engagement and disengagement is then considerably shorter than if the clutch is closed each time so far that the maximum transferable torque can be transferred. The reduction in operating time of the clutch which can thereby be achieved is an important argument for an automatic clutch being generally accepted by users.

The torque transfer control of the automatic clutch which is possible through the teaching according to the invention makes it possible to provide a creeping process in which the clutch is not completely opened but is only closed so far

that the vehicle creeps. Starting off and more particularly parking the vehicle thereby becomes much easier.

If the teaching according to the invention is used with an automatic clutch then a system of master cylinder, connecting device and slave cylinder is preferably used wherein the piston of the slave cylinder acts directly on the disengagement device of the clutch. The piston of the master cylinder is controlled into predetermined positions through a piston rod of an electrically operated motion device precisely by means of a sensor device.

With this design a snifting opening is preferably provided in the cylinder wall as snifting bore, ie a bore with relatively small diameter of eg 1 mm or less, which is connected through a hose connection or the like with a fluid-filled compensating container. This snifting opening is arranged in the area of the first dead point of the piston wherein the first dead point is the point which has the maximum distance from the connecting device. The clutch is designed so that the clutch is located in the completely closed state when the piston is in the first dead point.

The snifting cycle is then designed so that the piston is moved from the relevant position to the first dead point wherein the clutch is completely closed. Since the clutch was previously located in a state where it can anyhow transfer more torque than is actually necessary the complete closing of the clutch is not noticed by the driver. On the way to the first dead point the piston travels over the snifting bore and thereby closes same. During further movement to the first dead point the snifting bore is again opened and the piston is stopped as soon as it is located in the area between snifting bore and first dead point. In this state there is a flow connection between the compensating container, snifting bore, master cylinder,

connecting device and slave cylinder. If a volume excess is present in the system section formed by the master cylinder, connecting device and slave cylinder, then the volume flows through the snifting bore to the compensating container. If a volume deficit occurs then a corresponding amount of fluid is sucked in by the system section.

In the "snifting bore opened" state, all movable parts of the system section are located in a position predetermined for the actual operating state. This position is preferably through the first dead point of the master cylinder and through the first dead point of the slave cylinder which corresponds to the "clutch completely closed" state. Since these states during operation of the vehicle can always be reached with great precision and independently of the manufacturing tolerances of the individual component parts, after the snifting cycle always exactly the same fluid volume is enclosed in the system section. The movement of the piston in the master cylinder after the snifting cycle over a predetermined path length will always produce exactly the same displacement of the piston in the slave cylinder.

The snifting cycle is preferably repeated in short time intervals which are preferably within the minute range. It is thereby ensured that even with a rapid temperature rise, ie a high temperature gradient, the volume is kept constant with sufficient accuracy. The snifting cycle preferably takes place in time intervals of 10 to 300 seconds, particularly between 20 and 200 seconds and more specifically preferred every 40 to 80 seconds.

There are various variations for the snifting cycle itself. Generally the piston is sealed with an elastic sealing element from the cylinder of the master cylinder. A certain maximum travel speed is therefore allowed so as not to damage the seal on the one hand and also not to overload the

motion device on the other hand.

Both the diameter and the position of the snifting bore within the cylinder are liable to manufacturing tolerances. The same also applies for the piston, any possible seal and the motion device as well as the elements which transfer the movement to the piston. The precision of the control of the kinetic device can therefore be increased if in a learning mode the position of the snifting bore is fixed with greater accuracy than is possible from the structural design taking into account the tolerance values.

The invention proposes for this several methods of procedure. First it is basically common to all methods that more or less voluntarily a starting point is fixed for determining the snifting bore. This starting point can be for example the first dead point of the piston or however also a position occupied in the area of the first dead point. For this starting position the output signal of the sensor device is stored.

Detecting the snifting bore can be carried out in a first method of procedure by moving the piston with one or more predetermined speed profiles in the cylinder, and thereby observing physical values which are dependent on the position of the snifting bore. Thus for example the piston can be moved with different speeds from the start position (clutch closed) into the other extreme position (clutch opened) and the pressure build up thereby observed. Since even with Newton's fluids the flow resistance depends on the shear incline, the different speeds produce different pressure paths which where applicable, depending on design, also leads to a different end position of the piston in the master cylinder with the "clutch opened" position.

Through an analysis of the sensor signal recorded during

movement it is possible to determine the position of the snifting bore.

Alternatively or additionally a further sensor can also be used, for example a pressure sensor in the master cylinder, in the connecting device or in the slave cylinder, a force measuring device for measuring the force required for displacing the piston or a sensor which additionally detects the path stretch covered by the piston of the slave cylinder or by the disengagement device or an element of the clutch.

Since the learning process must as a rule only take place once, eg with first start-up of the vehicle, one or more parts of the corresponding devices can also be released from the function combination. Thus for example the connection device can be released from the pressure generating device and master cylinder respectively and the connection of the snifting bore to the compensating container can be released.

The master cylinder can then be filled with a medium, preferably with compressed air, and the pressure produced by the medium in the snifting bore can be measured with a sensor, for example a pressure sensor, during the movement of the piston.

More particularly during flow through the master cylinder, but not exclusively, it is expedient to optimize the strategy for determining the actual snifting bore position.

This can happen in that the piston is moved starting from a determined position in predetermined steps until the opening of the snifting bore is detected. As start position a position is preferably selected here where the piston is safely located in a position where no flow connection exists between the snifting bore and the pressure outlet of the master cylinder. As soon as the snifting bore position has

been detected the process can be repeated from a changed start position with smaller step width so that the beginning of the opening of the snifting bore which is significant for the design of the snifting cycle can be detected with precision.

Instead of this method other search strategies are also possible. Thus in particular interval multiplexing can be used whereby the piston is first brought into a first start position in which no flow connection exists between snifting bore and pressure outlet of the master cylinder, then into a second position in which this connection is provided, whereupon then the piston is each time moved into the middle of the path stretch lying between the two preceding positions and it is determined whether this position lies on one or other side of the snifting bore.

A method of this kind has the advantage that the number of steps which is required to detect the snifting bore with a predetermined accuracy is fixed in advance. Particularly when measuring the snifting bore on the belt during production or during activation it is possible to determine the snifting bore position with an accurately known number of method steps.

Further advantages, features and possibilities for using the present invention will be apparent from the following description of an embodiment in connection with the drawings in which:

Figure 1 shows a diagrammatic illustration of a part of the drive device of a motor vehicle in which the present invention is embodied;

Figure 2 is a diagrammatic sketch illustrating the method according to the invention;

Figure 3 is a partial diagrammatic sectional view on an

enlarged scale of the pressure generating device and a piston moving therein to explain the method according to the invention.

A first embodiment of the invention will now be described with reference to Figure 1.

A motor vehicle has a drive engine, namely an Otto cycle engine or diesel engine which is controlled by an electronic engine control system. The electronic engine control system is connected inter alia with sensors for detecting the amount of intake air and the actual crankshaft speed and allows the torque produced each time by the engine to be determined. The rotary movement of the engine is transferred through a flywheel and automatic shift clutch to a shift gear which has five forward gears, a neutral gear (idling) and a reverse gear. The shift gear is shifted by the driver through a gear shift lever mounted in the vehicle.

The output speed of the shift gear is transferred through a compensating gear to the driven wheels of the vehicle. The engine, engine control, structural design of the clutch, shift gear and compensating gear are of the conventional construction known from the prior art and are therefore not shown in the drawings and also need not be explained in further detail.

The automatic clutch is controlled through a clutch control device. This clutch control device receives signals from the engine control and is connected to a sensor provided on the shift rod. As soon as the speed of the engine drops below a predetermined value or if through a change in the sensor signal on the shift rod a desire to change gear is detected, then the clutch control unit sends a signal to open the clutch.

The clutch itself is likewise of the conventional construction and is designed as a single disc dry clutch which is brought by a disengagement lever into a disengaged position. In order for the user to be able to open the clutch without operating a clutch pedal, the disengagement lever has to be moved out of the closed position into a corresponding opened position. This movement is carried out against the force of compression springs which hold the clutch in the closed state.

In Figure 1, 1 indicates the clutch control device which as shown diagrammatically is connected to the engine control device 2 and a shift desire detection device 3.

If the clutch control device determines that the clutch is to be operated then a corresponding command is sent to an electric motor 10. The electric motor 10 has a motor output shaft 12 whose rotation drives a gearbox marked overall by 14. The rotary movement of the motor is reduced and converted by a crank drive into a translatory movement. The crank drive has a rotating disc 16 which rotates in the direction of the arrow 17 about a shaft 18 and drives a crank 20 which is mounted for articulation on this disc and which is connected by an articulated joint 22 to a piston rod 24. The piston rod 24 extends in a cylinder 30 on whose (left - in the drawing) side is provided a cover 32 which is sealed from the piston rod 24 by a seal 34. The piston rod is connected by an articulation joint 36 to a piston 38. The piston 38 has a valve, in the embodiment a plate valve 40, whose function will be explained in further detail below. On its circumference the piston supports a circumferential seal 42.

The cylinder is closed at its front end section 43 by a plate 44 which has an outlet 45 with threaded pipe 46.

The piston and cylinder together form a pressure generating device wherein the opening 45 forms the pressure outlet. As a result of this function the cylinder with piston 38 is also termed master cylinder. A second cylinder 60, the slave cylinder, likewise has a piston 62 on which a piston rod 64 is mounted. In the front end area 63 of the cylinder 60 is a plate 66 in which a full-length opening with screw-on pipe 68 is mounted. A hose 50 is firmly screwed onto the screw-on pipe 68. The hose thus forms a connecting device for connecting the master and slave cylinders.

The cylinder 30, hose 50 and cylinder 60 are completely filled with a hydraulic fluid, namely with a brake fluid of known physical and chemical characteristics.

If the piston 38 is moved by the motor 10, namely towards the end 44 of the cylinder 30, the pressure is increased in the (right - in the drawing) cylinder chamber B, in the hose and in the slave cylinder. The piston 62 is thereby displaced towards arrow 66 and operates the (not shown) disengagement device of an otherwise conventional single disc dry clutch.

If the piston 38 is moved in the master cylinder away from the pressure outlet 45 (to the left in the drawing), the pressure in the chamber A can be increased. The plate valve 40 can thereby opened so that the hydraulic fluid can flow from the chamber A into chamber B.

In order to detect the position of the piston 38 a sensor 70, shown diagrammatically, is provided on the piston rod 24 and is connected to a pressure generating control device 72. The pressure generating control device is in turn connected to the clutch control device 1. It should be pointed out at this point that the pressure generating control device can also be integrated in the clutch control device.

Furthermore it is possible to integrate both the clutch control device and also the pressure generating device into a superordinate control unit which controls further or practically all vehicle functions.

The chamber B of the cylinder 30, the hose 50 and the pressure chamber of the cylinder 60 form a system section. In order to keep the volume of the pressure fluid constant in this system section, a snifting bore 80 is provided which has a diameter of about 0.7 mm and is circular cylindrical. The snifting bore arranged in the wall 37 of the cylinder 30 is in flow connection with a hose connecting pipe 82 through which the snifting bore is connected to the compensating container 86 by means of a hose 84. The cover 88 which closes the compensating container 86 has a pressure compensating bore 87 so that the pressure of the fluid in the compensating container on the fluid surface is always equal to the ambient pressure of the vehicle.

On the condition that the fluid volume enclosed in the system section is constant, a certain position of the piston 30 which can be detected through the sensor device 70 corresponds to a certain position of the piston 62 and thus also to a certain position of the disengagement device. If the volume of the hydraulic fluid changes, for example through a change in temperature, then the association between the two piston positions and thus also the association between the position of the master cylinder and engagement state of the clutch changes.

In order to keep the volume constant, a snifting cycle is carried out in regular intervals, which proceeds as follows:

With the illustrated embodiment the position where the piston 62 of the slave cylinder 60 is located in its left end position, corresponds to the state of the complete

closing of the clutch. In this state the clutch can transfer the maximum torque. For the master cylinder there are substantially three operating states which are shown graphically in Figure 2. If the piston is located in the illustration there left of the snifting bore, ie in the area I, a flow connection exists between the outlet container 101, snifting bore (100) and system section. If the piston is located within the area II, the snifting bore is completely closed. The width of area II depends on the ratio of the diameter or longitudinal extension of the snifting bore in the cylinder longitudinal direction to the length of the sealing element in the longitudinal direction of the cylinder. If the sealing element is for example 5 times wider than the through section of the snifting bore, then the length of the area II in which the snifting bore is completely closed corresponds to three times the diameter of the snifting bore.

If the piston is moved from the first dead point which is the dead point at the left end of the area I, towards the snifting bore, then with slow movement no pressure build up occurs in the cylinder chamber B since the entire fluid volume is forced through the snifting bore into the compensating container. As soon as the piston closes the snifting bore in the area II, during further movement to the right a build up of pressure takes place. The level of the pressure build-up is comprised from the (small) flow losses of fluid in the system section, the pressure which is required to overcome the friction force counteracting the displacement of the piston 62, and the pressure resulting from the disengagement force of the clutch. If the compression springs of the clutch substantially follow for example Hook's law, then the pressure rises substantially proportionally along the displacement path. With another characteristic of the clutch characteristic line another pressure rise follows as a function of the displacement

path.

In the pressureless state the clutch is completely closed. With the increase in pressure the disengagement device counteracts the force of the compression springs so that the contact pressure force of the clutch is reduced. Thus the torque transferable by the clutch also drops. Since the transfer of the full engine torque through the clutch is however required only in relatively seldom cases, in most cases a reduced contact pressure force is sufficient to ensure torque transfer without slip. The contact pressure force of the clutch and thus the torque is thus set through the position of the piston. The area III is therefore also termed modulation area.

With each snifting cycle the piston is moved back completely into area I. The snifting bore and the compensating container are thereby connected to the inside of the cylinder so that the entire system becomes pressureless or assumes ambient pressure. In this state the clutch is completely closed and the piston of the slave cylinder is located in the position which corresponds to the completely closed clutch.

As soon as the piston has reached area II on moving back, the volume compensation starts and too much or too little fluid volume is compensated. When the two pistons have reached their end position, after a corresponding compensation time, a completely exactly defined fluid volume is located inside the system section wherein it should be pointed out that the snifting bore, the hose 84 and the compensating container 86 themselves do not belong to the system section.

The piston is then moved back again and a pressure rise begins depending on the travel speed, viscosity of the

hydraulic fluid and the flow resistance of the snifting bore already in area I, although this pressure rise is negligible with a smaller travel speed. As soon as position II is reached, the actual pressure build up starts and the piston is moved into the position predetermined by the pressure generating device.

At which time intervals a snifting cycle is to be carried out depends on the heat expansion coefficient of the fluid and on the amount of fluid found overall in the system section. With a higher volume and higher heat expansion coefficient a lower time interval is required between two snifting cycles than with lower volume and smaller heat expansion coefficient. Repeating the snifting cycle in a time range between 20 seconds and 180 seconds has proved particularly suitable. Particularly preferred is a value between 120 seconds and 30 seconds, and more particularly between 40 seconds and 90 seconds.

An important advantage in the snifting cycle described is the fact that the snifting cycle in no way changes or involves the operating state of the vehicle. The driver does not notice the snifting cycle and also the control of the automatic clutch can take place in a manner remaining unaffected by the snifting cycle. This is reached in that the snifting cycle is immediately broken off when the clutch control device recognizes a shift desire and issues a shift command which makes the disengagement of the clutch necessary.

The snifting cycle can be carried out in that the piston 36 is driven with maximum speed in area I wherein the maximum speed is dependent on the design of the motion device and on the maximum displacement speed permissible for the seal. The piston is then moved back again at maximum speed into the area II into the previous position or the now newly

preset position. This design of the snifting cycle has the advantage that the time taken for reaching the snifting position is minimized.

According to an alternative embodiment the speed path during snifting is selected quite different. The clutch is also here closed with minimum speed, ie the piston is moved with maximum speed from area III to area I. The piston is then held in the position in which the snifting bore is opened wherein this holding time is preferably in the range from 0.01 and 0.5 sec, preferably in the range between 0.06 and 0.2 sec.

The piston is then moved back but with stepped speed. A low speed is selected within the area I and II and so far in area III until the piston with the sealing element has again released the snifting bore completely. The speed thereby preferably amounts to be 1% and 20%, preferably between 5% and 15% of the maximum speed permissible. As soon as the point is reached in which the snifting bore is completely open the clutch is then moved back at maximum speed into the previous position or into the now valid new position.

This method of procedure has the significant advantage that the cycle time is indeed very small which is achieved through the maximum travel speed when closing the clutch and in the last phase. On the other hand the sealing element is improved through the slow transfer in the opening direction since prior to travelling over the snifting bore no noticeable pressure can build up which could deform the seal relative to the snifting bore and could thus lead to premature wear.

This method of procedure has a particular advantage for transporting gas bubbles, more particularly air bubbles in the system.

Through the rapid drop in pressure when closing the clutch the air bubbles are carried along towards the snifting bore. Since the snifting bore is preferably arranged so that seen in cross section it is arranged at the highest vertical point of the cylinder, the air bubbles have in this phase time to escape through the snifting bore. If as preferred the system is designed so that the master cylinder is arranged higher vertically than the connecting device and slave cylinder then through the snifting process a constant transport of any gas bubbles arising takes place towards the snifting bore and through the snifting bore out from the system section.

The position of the snifting bore is structurally preset but subject to manufacturing tolerances. The modulation area III must be selected so that the seal 42 of the piston 36 does not contact the snifting bore. Otherwise the danger of premature wear of the seal would arise. This danger is more particularly great when, as preferred, a lip seal is chosen as the seal which is pressed by the then prevailing pressure into the snifting bore. Of the modulation area III therefore only one area IV can in practice be used which is likewise shown in Figure 2. Since the length of the modulation area required is structurally predetermined, the cylinder must be formed correspondingly long so that the distance from area IV to area II is sufficiently large. Thus on the one hand the master cylinder is enlarged and on the other hand the snifting time is extended since the path stretch to be covered becomes greater. The tolerance must moreover be considered not only in the modulation area but also in area I since also here it must be ensured that the snifting bore is completely opened during snifting.

The disadvantages described above are at least partially avoided by localizing the snifting bore exactly in the individual master cylinder.

For this the pressure generating control device is changed over from normal operating mode in which the pressure generation is controlled to a learning mode which is implemented when first bringing the vehicle into operation or after a corresponding repair. For learning mode, in the embodiment, the hose 50 and hose 84 are removed from the master cylinder. A pressure measuring device is fitted on the connecting pipe 82 of the snifting bore 80.

Figure 3 shows on an enlarged scale the inside wall 37 of the cylinder with the snifting bore 80. The seal 42 of the piston 36 is shown underneath. In the illustration according to Figure 3 the front edge of the seal 42 is located exactly underneath the foremost position of the snifting bore, ie exactly in the point in which the opening of the snifting bore begins. This point is marked by X on the x-axis set underneath and parallel to same.

In order to detect the snifting bore compressed air is blown into the cylinder through the pressure outlet. The piston is then moved through the motion device from a fixed starting position, eg a starting position A into the position of the support point S_1. In this position there is no flow connection with the snifting bore and there is no pressure shown in the snifting bore.

The piston is then moved to support position S_2. In this position there is a flow connection and a pressure is shown in the snifting bore. The interval I_1, with the interval length L_1 is now exactly halved from which the support position S_3 is produced. The measurement is now carried out for support position S_3 from which in the present case it results that the sought position X must lie in the right hand half of this interval. The interval is then halved again from which the support position S_4 is produced and it is again established for this support position S_4 that no

flow connection arises.

This interval multiplexing is carried out for a predetermined number of intervals. Since the output step length L_1 is preset this leads with a fixed number of steps to a predetermined tolerance range for detecting the snifting bore position which can be for example in an area of 20μm or less. In order to rule out possible hysteresis influences of the master, the interval multiplexing can be carried out so that each point is started off from the starting position A.

The advantage of this interval multiplexing is that with each individual master cylinder an exactly even number of steps is required in order to achieve the desired accuracy,.

As an alternative to this the snifting bore can also be detected in a way that the area between S_1 and S_2 is searched with constant step width. Thus the piston can be moved with each step by 50 μm. From this the location of the snifting bore is carried out with computerized accuracy of 25 μm. The disadvantage here however is that the number of steps up to finding the snifting bore position varies from cylinder to cylinder.

The method can be improved so far by first making a detection with a rough step width and then as soon as the bore is detected detecting the area coming into question with a smaller step width.

The two mechanisms previously explained require a change in the structural design in order to blow the medium eg compressed air into the cylinder.

With an alternative of this embodiment blowing in air is not necessary. With this alternative the pressure is detected

in the hydraulic system, in the connecting direction or the like. The piston is moved to the right starting from the left dead point in Figure 1 with different travel speeds. Thereby both the path signal of the sensor device as well as the pressure signal is detected. As already indicated, the different travel speed causes a different pressure build up inside the area I. Through an analysis of the pressure paths it is possible to determine very reliably the position of the snifting bore from the values gained from experiments.

Instead of pressure measurement it is also possible to determine the disengagement path of the clutch. If with a high travel speed in area I the pressure is already relatively high at the beginning of area II then from a certain position of the cylinder III the pressure becomes higher than with a slow travel speed. With a higher travel speed a higher pressure is present at the same position and thus the clutch is opened further than at lower travel speed. Since the pressure build up is only dependent inside area I on the travel speed, it is possible to determine from the disengagement path the position of the snifting bore in the individual cylinder. It is thus sufficient here to establish at which displacement path the clutch is completely opened.

If the system is designed so that after reaching the opened position further movement of the piston of slave cylinder is no longer possible then the movement of the piston of the slave cylinder is stopped in this position since then for displacing the piston a (in theory) very large force would be required which cannot be applied by the motion device. From the end point of the movement of the piston of the master cylinder it is thus possible to determine the pressure build in area I and thus the position of the snifting bore.

According to a further alternative for detecting the snifting bore position a predetermined engagement point of the clutch is checked. With a preferred embodiment of the automatic clutch the clutch is controlled in neutral gear so that a creeping operation of the vehicle is possible similar to that with an automatic gearbox with hydrodynamic converter. The engagement point of the clutch, with a medium sized vehicle this is for example in the area between 8 and 10 Nm, is checked in the vehicle and is set within the scope of an engagement point adaption to the predetermined value. If the piston is rapidly moved inside area I, the pressure is higher and the clutch engagement point is reached at an earlier position than with a slow travel speed in area I. By analysing the position of the piston 36 on reaching the engagement point with different travel speeds in area I it is thus possible to likewise detect the position of the snifting bore with individual cylinders.

The position of the snifting bore is stored after the detection process in a memory device of the pressure-generating control device which allows long term store and is taken into consideration when controlling the clutch and when controlling the snifting cycle.

It is advantageous if with a snifting process in a first partial area of the clutch operating path the clutch is closed more slowly than in a further partial area of the clutch operating path. The first partial area can be restricted to transferable torques in the range from 3 Nm to 50 Nm.

A snifting process can also be carried out with an automated gearbox if with this gearbox in addition to the automated operation of the gear shift process the clutch operation is also carried out automatically. A snifting process is for example then possible if the gearbox is shifted in neutral

position. In this gear setting a snifting process can be controlled. Similarly with a shift process the neutral position can be set at least temporarily so that a snifting process can be carried out.

A snifting process is also possible with an at least substantially stationary vehicle when the brake is activated.

In the case of vehicles, detecting a high urgency of a snifting process can also be carried out also in a position of a gear selector element in a position which characterises a fully automatic gear shift mode, or in a position which characterises a manual gear shift mode or in a position with a gear engaged in the gearbox. The actor operating the gearbox can thereby shift the gear at least temporarily into a neutral area, carry out a snifting process and then shift into another or the previous gear position.

In such a situation a shift process can also be slowed down or delayed for carrying out a snifting process in order to carry out the snifting process for example in the neutral position or in another gear position.

The shift process can be carried out slowly for example in the following operating situations in order to carry out a snifting process:

- when the last snifting process lasts longer than a predefinable time span;
- and/or when on calculating the temperature of a hydraulic path this is detected as necessary because for example a temperature boundary value has been exceeded.

Thus a snifting process can be carried out through the engagement of the control on the gear shift operation.

The patent claims filed with the application are proposed wordings without prejudice for achieving wider patent protection. The applicant retains the right to claim further features disclosed up until now only in the description and/or drawings.

References used in the sub-claims refer to the further design of the subject of the main claim through the features of each sub-claim; they are not to be understood as dispensing with obtaining an independent subject protection for the features of the sub-claims referred to.

The subjects of these sub-claims however also form independent inventions which have a configuration independent of the subjects of the preceding sub-claims.

The invention is not restricted to the embodiment of the description. Rather numerous modifications and alterations are possible within the framework of the invention, more particularly those variations, elements and combinations and/or materials which are inventive for example through combination or modification of individual features or elements or method steps contained in the drawings and described in connection with those in the general description and embodiments and claims and lead through combinable features to a new subject or to new method steps or sequence of method steps where they relate to manufacturing, testing and work processes.

PATENT CLAIMS

1. Method for operating a motor vehicle and more particularly for operating the drive device of a motor vehicle which has at least one kinetic device operated by a fluid wherein at least one pressure generating device is provided in which the fluid is set under pressure as well as a connecting device which causes a flow connection between this pressure generating device and this kinetic device, characterised in that at least one pressure generating device forms a system section with a kinetic device and a connecting device and that the amount of fluid provided in this system section is kept substantially constant.

2. Method according to claim 1 characterised in that the fluid pressure is produced substantially hydrostatically.

3. Method according to claim 1 or 2 characterised in that the fluid pressure is substantially produced by a displacement action.

4. Method according to at least one of claims 1 to 3 characterised in that the fluid pressure is produced by at least one displacement element moving in a chamber.

5. Method according to claim 4 characterised in that the fluid pressure is produced by at least one piston moving in a cylinder and forming the displacement element.

6. Method according to claim 4 or 5 characterised in that the movement of this displacement element or this piston is between a first and second extreme position.

7. Method according to claim 6 characterised in that this displacement element or this piston can occupy a number of intermediate positions between this first and this second

extreme position.

8. Method according to at least one of claims 1 to 7 characterised in that the pressure generating device is controlled by a pressure generating control device.

9. Method according to claim 8 and one of claims 4 to 7 characterised in that the pressure generating control device controls the position of this displacement element.

10. Method according to claim 8 or 9 characterised in that at least one sensor device has at least one sensor whose output signals are taken into account when controlling this pressure generating control device.

11. Method according to at least one of claims 4 to 10 characterised in that this displacement element is moved by a motion device.

12. Method according to claim 11 characterised in that this motion device is controlled by this pressure generating control device on the basis of output signals of this sensor device.

13. Method according to claim 11 or 12 characterised in that the motion device converts rotating movement into translatory movement.

14. Method according to claim 13 characterised in that the conversion of the rotating movement into a translatory movement is carried out by means of a gearbox such as a crank gearing wherein this gearbox has at least one element which executes a rotating movement and at least one element which executes a substantially translatory movement.

15. Method according to at least one of claims 11 to 14

characterised in that this motion device converts electrical energy into kinetic energy.

16. Method according to claim 15 characterised in that this motion device has an electric motor.

17. Method according to claim 15 and 16 characterised in that this electric motor is connected to the element of the gearbox, such as crank gearing, which executes a rotating movement and this displacement element is connected to the element which executes a substantially translatory movement.

18. Method according to at least one of claims 10 to 17 characterised in that this sensor device detects the movement of this displacement element by detecting the movement of a component part which is connected to the displacement element.

19. Method according to at least one of claims 10 to 18 characterised in that this sensor device has at least one sensor which is selected from a group of sensors which are provided to measure a path stretch or turning angle and which comprise electrical, more particularly inductive and capacitative as well as optical and electro-optical sensors.

20. Method according to at least one of claims 10 to 19 characterised in that this sensor converts a physical value into an analogue electrical signal.

21. Method according to at least one of claims 10 to 19 characterised in that this sensor detects a certain event and issues an impulse when this event has happened.

22. Method according to claim 21 characterised in that a counter is connected in after this sensor which detects an event.

23. Method according to at least one of claims 1 to 22 characterised in that this kinetic device has at least one functional element moving through fluid pressure.

24. Method according to claim 23 characterised in that the movement of this function element takes place between a first and second extreme position.

25. Method according to claim 24 characterised in that this function element can occupy a number of intermediate positions between this first and this second extreme position.

26. Method according to at least one of claims 23 to 25 characterised in that the fluid pressure exerts a substantially displacement action on this at least one function element.

27. Method according to claim 26 characterised in that the fluid pressure acts on a displacement element moving in a chamber.

28. Method according to claim 27 characterised in that the fluid pressure acts on at least one cylinder moving in a cylinder as displacement element.

29. Method according to at least one of claims 1 to 28 characterised in that this connecting device forms a flow channel between at least one pressure outlet of this pressure generating device for the pressurised fluid and at least one pressure inlet of this kinetic device for the pressurised fluid.

30. Method according to at least one of claims 1 to 28 characterised in that the connecting device contains a hose connection.

31. Method according to at least one of claims 1 to 30 characterised in that this connecting device contains a pipe connection.

32. Method according to at least one of claims 1 to 31 characterised in that the fluid is a liquid and that this amount to be kept constant is the liquid volume.

33. Method according to claim 27 characterised in that this volume to be kept constant is determined by a defined position of the pressure generating device, connecting device and kinetic device which form this system section.

34. Method according to claim 33 and at least one of claims 7 to 32 characterised in that this defined position of the pressure generating device is one of the two extreme positions.

35. Method according to claim 33 and at least one of claims 24 to 32 characterised in that this defined position of the kinetic device is one of these first or second extreme positions.

36. Method according to at least one of claims 1 to 35 characterised in that this pressure generating device forming the system section and this kinetic device interact so that a certain state of the pressure generating device corresponds to a certain state of this kinetic device.

37. Method according to at least one of claims 6 to 36 characterised in that a certain position of this displacement element or of this piston of this pressure generating device corresponds to a certain position of this displacement element of this kinetic device.

38. Method according to at least one of claims 1 to 37

characterised in that this pressure generating device has a piston moving in a cylinder and displaceable between a first extreme position and a second extreme position in order to produce a fluid pressure wherein this piston can occupy a number of positions between this first extreme position and this second extreme position, that this kinetic device has a piston moving in a cylinder which can move between a first and second extreme position and can thereby occupy a number of intermediate positions an that this pressure generating device, this kinetic device and this connecting device are provided so that a certain position of this piston in this pressure generating device corresponds to a certain position of this piston in this kinetic device.

39. Method according to at least one of claims 32 to 38 characterised in that this fluid volume is kept constant by bringing the pressure generating device and the kinetic device into this defined position and by supplying or discharging fluid through a fluid compensating device in this defined position.

40. Method according to claim 39 characterised in that this fluid compensation is carried out by opening a flow connection between the fluid compensating device and this system section.

41. Method according to claim 39 or 40 characterised in that this fluid compensation device has a fluid container in which the fluid is kept under a predetermined pressure.

42. Method according to claim 41 characterised in that this predetermined pressure is the ambient pressure.

43. Method according to at least one of claims 39 to 42 characterised in that this fluid compensation is carried out through a flow connection provided in this pressure

generating device.

44. Method according to claim 43 and at least one of claims 5 to 42 characterised in that this flow connection has an opening in a cylinder wall of this cylinder of this pressure generating device.

45. Method according to claim 44 characterised in that this opening is arranged at the vertically highest position of the cylinder wall, seen in cross section.

46. Method according to one of claims 44 or 45 characterised in that this opening is formed as a substantially cylindrical bore in the cylinder wall and has a diameter of less than 2. 5 mm.

47. Method according to at least one of claims 1 to 46 characterised in that this kinetic device operates an element which changes the translation of a gearbox.

48. Method according to at least one of claims 1 to 46 characterised in that this kinetic device operates an element which influences the state of a clutch device..

49. Method according to claim 48 characterised in that this kinetic device operates a disengagement device of a clutch device.

50. Method according to at least one of claims 1 to 49 characterised in that this kinetic device has a piston which is movable inside a cylinder, that this piston is displaced by this fluid pressure and that this piston is connected to the disengagement device of a clutch device and is displaceable at least between two positions, namely a first position where the clutch is opened so wide that only a slight or no torque is transferred and a second position

where the clutch is completely closed.

51. Method according to at least one of claims 1 to 50 characterised in that this kinetic device is connected to a clutch device and that this kinetic device influences at least one element of this clutch device so that the clutch device can be brought into a number of states which each allow the transfer of a torque with a substantially preset level.

52. Method according to at least one of claims 1 to 51 characterised in that this kinetic device operates an element which influences the state of a clutch device, and that through this kinetic device the state of the clutch device can be changed so that it can be transferred infinitely from a first state which allows the transfer of a or only a slight torque into a second state where the transfer of the maximum possible torque for the clutch device takes place, wherein between this first state and this second state any number of intermediate states can be reached which each allow the transfer of a torque with a substantially predetermined level.

53. Method according to at least one of claims 32 to 52 characterised in that the fluid volume is kept constant by bringing this kinetic device and the element operated by the kinetic device into a substantially predetermined position.

54. Method according to claim 53 characterised in that during operation of this drive device this kinetic device and this element are brought into this position with time gap in order to carry out compensation of the fluid volume.

55. Method according to at least one of claims 46 to 54 characterised in that this pressure generating device has a cylinder in which a piston is mounted displaceable and that

in this cylinder wall this opening which serves for fluid compensation is provided and this piston is displaceable in this cylinder so that it can occupy at least three position areas, namely a first position area in which no flow connection exists between this opening, this connecting device and this kinetic device, a second position area where a flow connection is provided between this opening, this cylinder, this connecting device and this kinetic device, and a third position area where this opening is completely closed.

56. Method according to claim 55 characterised in that this fluid volume compensation is carried out by moving this piston from this third position through the second position into the first position (snifting cycle).

57. Method according to claim 55 or 56 characterised in that this snifting cycle is controlled by this pressure generating device.

58. Method according to claim 57 characterised in that this pressure generating control device controls the snifting cycle taking into account the signals of this sensor device.

59. Method according to claim 58 characterised in that this pressure generating control device is switched from a first operating mode which is formed as a learning mode and in which the position of this snifting opening is detected, into a second operating mode which corresponds to the normal operation of the vehicle and wherein this snifting cycle is used to keep constant the fluid volume located in this system section.

60. Method according to claim 59 characterised in that this pressure generating control device is connected to a memory device in which stored data can be kept long term.

61. Method according to claim 59 or 60 characterised in that in this learning mode the piston of the pressure generating device is brought by this motion device into at least two positions wherein this piston can open this snifting opening in a first position and close it in a second position.

62. Method according to claim 61 characterised in that at least one sensor device is provided which has at least one sensor which detects a physical value which is subjected to change when this piston is brought from this first position into the second position.

63. Method according to claim 62 characterised in that this sensor is a sensor which detects the pressure in a flow channel which is connected to this snifting opening.

64. Method according to claim 63 characterised in that this pressure generating device is brought into connection with a pressure source during this learning mode.

65. Method according to claim 64 characterised in that this pressure source is a compressed air or fluid pressure source.

66. Method according to at least one of claims 59 to 65 characterised in that this pressure generating control device controls this movement device so that the position of the snifting opening is detected in a substantially predetermined number of steps.

67. Method according to at least one of claims 59 to 66 characterised in that at the start of the learning mode this pressure generating control device checks whether the snifting opening is located within the predetermined tolerance values.

68. Method according to claim 67 characterised in that this check is carried out by bringing the piston of this cylinder device first into a position which corresponds to the first tolerance boundary value and then into a second position which corresponds to the second tolerance boundary value and thereby establishing whether a flow connection is made with the pressure source.

69. Method according to at least one of claims 59 to 68 characterised in that the detection of the position of the snifting opening begins from a start position which lies within the normal operating position area (third position area III).

70. Method according to at least one of claims 59 to 69 characterised in that this method for detecting the position of the snifting process begins from a start value and that starting from this start value the position is changed each time stepwise by a predetermined step length wherein after reaching each new position it is checked whether this second position in which the snifting opening is closed has been reached.

71. Method according to claim 70 characterised in that this step width is changed as soon as this second position in which the snifting opening is closed is reached and that, starting from the relevant last or penultimate position the method is repeated with a reduced step width.

72. Method according to at least one of claims 59 to 69 characterised in that the method for detecting the position of the snifting opening is carried out during the course of an interval multiplexing.

73. Method according to claim 72 characterised in that the method of interval multiplexing is carried out by first

carrying out a first measurement in a first position for the interval O wherein in this position the flow connection with the snifting opening does or does not exist, and that then a second measurement is made for the interval O at a distance of l_o from this first position in a second position in which the flow connection does not or does exist, and that then the interval l_o is divided each time wherein the measuring positions resulting therefrom are selected so that they always have opposite operating states, ie flow connection is or is not present.

74. Method according to at least one of claims 59 to 69 characterised in that the position of the snifting opening is determined by moving the piston in this cylinder so that the snifting opening changes its state from opened to closed or from closed to opened, that during the movement the actual position of the piston is marked and a signal is recorded from a pressure sensor and that the position of this snifting bore is derived from the change of pressure.

75. Method according to claim 74 characterised in that this pressure sensor is mounted in this snifting opening, that the pressure change is detected in the snifting opening.

76. Method according to claim 74 characterised in that this pressure sensor detects the pressure in this cylinder.

77. Method according to at least one of claims 74 to 76 characterised in that the cylinder is filled with air during this learning mode.

78. Method according to at least one of claims 74 to 76 characterised in that the cylinder is filled during this learning process with the same fluid with which it is also filled during the normal operation.

79. Method according to claim 48 and at least one of claims 55 to 78 characterised in that this normal operating position area (third position III) is a position area in which the torque transferable by the clutch is changeable through displacement of the piston (modulation area) and that this first position in which a flow connection is provided between this cylinder and this snifting opening is the condition in which the clutch is completely closed and the maximum torque is transferable.

80. Method according to claim 79 characterised in that this snifting cycle is carried out by the clutch moving from a partially opened state (modulation operation) into the completely closed state in which the opening is opened and that the position is then pushed back into the modulation area.

81. Method according to claim 79 characterised in that this state in which the clutch is completely closed is maintained for a predetermined time span wherein this time span is measured so that the time in which the snifting opening is opened is measured so that the volume change produced through a predetermined temperature change is at least partially compensated.

82. Method according to claim 80 or 81 characterised in that this time span in which the snifting opening is opened is less than 2 secs. and preferably less than 1 sec., more particularly preferably less than 0.5 sec. and even more specifically preferably less than 0.2 secs.

83. Method according to at least one of claims 59 to 82 characterised in that this snifting cycle is repeated in a predetermined time interval.

84. Method according to claim 83 characterised in that the

time sequence of two snifting cycles is dependent on the volume change which can be tolerated per time unit as a result of a temperature change which is to be expected.

85. Method according to claim 83 characterised in that the implementation of a snifting cycle is cancelled when at this unspecified time point a predetermined operating state is detected by the pressure generating device, at which the execution of the snifting cycle is not to happen.

86. Method according to at least one of claims 79 to 84 characterised in that the movement of the piston from the modulation area in which the clutch is partially opened into the position in which the clutch is completely opened takes place at the same speed at which the movement of the piston proceeds from the position in which the clutch is completely closed into the partially opened position.

87. Method according to at least one of claims 34 to 85 characterised in that this fluid is a liquid and that keeping the fluid volume constant involves an at least partial removal of gas bubbles found in the liquid.

88. Method according to at least one of claims 79 to 84 or 86 characterised in that the movement of the piston for closing the clutch takes place at a higher speed than the movement of the piston for opening the clutch.

89. Method according to at least one of claims 79 to 85 or 87 to 88 characterised in that this snifting cycle has four phases wherein the first phase involves the displacement of the piston for closing the clutch at high speed, the second phase the time span in which the piston is not moved in order to keep the snifting opening open, a third phase in which the piston is slowly moved up to a position which corresponds to the beginning of this modulation area (normal

operating area III) and a fourth phase in which the piston is moved at high speed into the end position provided by the control device.

90. Method according to at least one of claims 79 to 85 or 87 to 88 characterised in that this snifting cycle has four phases wherein the first phase involves the movement of the piston for closing the clutch at high speed, the second phase the time span in which the piston is not moved in order to keep the snifting opening open, a third phase in which the piston is slowly moved into a position which corresponds to the beginning of this modulation area and a fourth phase in which the piston is moved at moderate speed into an end position provided by the control device, wherein this speed is selected so that a transport of gas bubbles in the direction away from this snifting opening is substantially minimized.

91. Method according to claim 89 or 90 characterised in that the travel speed of the piston in this first phase is greater than 40 mm/sec, preferably greater than 100 mm/sec and more particularly preferably greater than 140 mm /sec.

92. Method according to at least one of claims 89 to 91 characterised in that this travel speed in the third phase is less than 100 mm/sec, preferably less than 50 mm/sec and more particularly preferably less than 20 mm/sec.

93. Method according to claim 79 and at least one of claims 48 to 78 or 80 to 92 characterised in that this clutch device is an automatic clutch device, that a clutch control device is provided which controls the operation of this automatic clutch and that this snifting cycle is broken off when this clutch control device issues a signal which changes the state of this clutch.

94. Method according to claim 93 characterised in that this command for changing the state of the clutch is the command for opening the clutch.

95. Method according to at least one of claims 1 to 94 characterised in that the chemical and physical nature of this fluid corresponds substantially to the chemical and physical nature of a brake fluid.

96. Method according to at least one of claims 8 to 95 characterised in that this pressure generating control device controls at least one method feature which is selected from a group of method features which comprise the change-over from learning mode to operating mode, the time point for the beginning of a snifting cycle, the length of a snifting cycle, the travel speed of the piston in at least one phase of a snifting cycle, on the basis of at least one actual operating value wherein this operating value is selected from a group of actual operating values of this motor vehicle which includes at least the ambient temperature, the actual speed, the actually engaged gear, the actually transferred torque, the actual rotary speed of at least one gearbox or motor element, as well as operating data of the motor, such as engine oil temperature, cooling water temperature, engine speed, engine torque.

97. Method according to at least one of claims 8 to 96 characterised in that this pressure generating control device is integrated in a control device which controls a further function of this motor vehicle which is selected from a group of function control devices which comprises a clutch control device, gear control device, engine control device, drive control device.

98. Method according to at least one of claims 8 to 97 characterised in that this pressure generating control

device is connected at least during the operation of this vehicle to a superimposed control device which controls the operation of the vehicle.

99. Motor vehicle with a drive unit which has at least one kinetic device operated by a fluid, wherein at least one pressure generating device is provided in which the fluid is set under pressure and at least one kinetic device operated by this fluid pressure, as well as a connecting device which causes a flow connection between this pressure generating device and this kinetic device, characterised in that at least one pressure generating device forms with a kinetic device and a connecting device a system section and that a device is provided in order to keep the amount of fluid present in this system section substantially constant.

100. Motor vehicle according to claim 99 characterised in that this pressure generating device has a displacement element moving in the chamber to produce this fluid pressure.

101. Motor vehicle according to claim 100 characterised in that this pressure generating device has at least one piston moving in the cylinder through which this fluid pressure is produced.

102. Motor vehicle according to at least one of claims 99 to 101 characterised in that this motor vehicle has a pressure generating control device through which the pressure generating device is controlled.

103. Method according to claim 102 characterised in that at least one sensor device is provided with at least one sensor whose output signals are taken into consideration by this pressure generating control device.

104. Motor vehicle according to claim 103 characterised in that this sensor device detects the position of an element which is in active connection with this displacement element or with this piston and its position changes when the position of this displacement element or this piston changes.

105. Motor vehicle according to at least one of claims 99 to 104 characterised in that a movement device is provided which moves this displacement element or this piston.

106. Motor vehicle according to claim 105 characterised in that this movement device has a gearbox to convert rotary movement into translatory movement.

107. Motor vehicle according to claim 106 characterised in that the movement device has a crank drive.

108. Motor vehicle according to at least one of claims 105 to 107 characterised in that an electrical drive unit is provided which drives this movement device.

109. Motor vehicle according to at least one of claims 99 to 108 characterised in that this kinetic device has at least one function element which can be moved by fluid pressure.

110. Motor vehicle according to claim 109 characterised in that the fluid pressure acts on a displacement element moving in a chamber of this kinetic device.

111. Motor vehicle according to claim 110 characterised in that this displacement element moving in a chamber is a piston moving a cylinder.

112. Motor vehicle according to at least one of claims 99 to 111 characterised in that this connecting device forms a

flow channel between at least one fluid pressure outlet of this pressure generating device and at least one fluid pressure inlet of this kinetic device for the pressure fluid.

113. Motor vehicle according to at least one of claims 99 to 112 characterised in that this connecting device involves a hose connection.

114. Motor vehicle according to claim 113 characterised in that this hose is provided so that the change of the flow volume is as a result of a change of the pressure of the fluid located in the hose by a predetermined amount below a predetermined boundary value.

115. Motor vehicle according to at least one of claims 99 to 114 characterised in that this connecting device involves a pipe connection.

116. Motor vehicle according to at least one of claims 99 to 115 characterised in that this pressure generating device has a piston mounted displaceable in a cylinder and that this kinetic device has a piston displaceable in a cylinder wherein this pressure generating device, this kinetic device and this connecting device are formed so that a predetermined position of this piston of the pressure generating device corresponds substantially to a predetermined position of the piston in the kinetic device.

117. Motor vehicle according to claim 116 characterised in that this piston of the pressure generating device is displaceable between two extreme positions and that this piston of this kinetic device is likewise displaceable between two extreme positions.

118. Motor vehicle according to at least one of claims 99 to

117 characterised in that the fluid is a liquid and that this device for keeping the fluid volume constant in this system section involves a fluid compensating container.

119. Motor vehicle according to claim 118 characterised in that this fluid compensating container is mounted so that the potential energy of the fluid located in the fluid container is greater than the potential energy of the fluid in this system section.

120. Motor vehicle according to claim 118 or 119 characterised in that the pressure of the fluid in this fluid container is substantially equal to the ambient pressure.

121. Motor vehicle according to at least one of claims 118 to 120 characterised in that a shift valve is mounted between this system section and this fluid compensating container.

122. Motor vehicle according to at least one of claims 118 to 121 characterised in that a hydraulic shift device is provided which can occupy at least two states, namely a first state in which a flow connection is opened between this fluid compensating container and this system section, and a second state in which the flow connection is closed between this fluid compensating container and this system section.

123. Motor vehicle according to at least one of claims 118 to 122 characterised in that a hydraulic shift device is provided which can occupy at least three states, namely a first state in which a flow connection is provided between this fluid compensating container and this system section, a second state in which this flow connection is closed and a third state in which a flow connection is provided between

this fluid compensating container and a pressure-neutral area of this system section.

124. Motor vehicle according to at least one of claims 121 to 123 characterised in that this hydraulic shift device involves a piston movable in a cylinder.

125. Motor vehicle according to claim 124 characterised in that this piston is the piston of this pressure generating device provided to produce pressure.

126. Motor vehicle according to claim 125 characterised in that this pressure generating device has a flow connection with this fluid compensating container.

127. Motor vehicle according to at least one of claims 99 to 126 characterised in that this system section has a snifting channel and that a control device is provided which causes the snifting channel to be brought into flow connection with this fluid compensating container at predetermined time points.

128. Motor vehicle according to claim 127 characterised in that this pressure generating device has a piston movable in a cylinder, that this kinetic device has a piston movable in a cylinder, and that this snifting channel has a snifting opening which opens into this cylinder of the pressure generating device, wherein this snifting opening has a predetermined dimension in the longitudinal direction of this pressure generating cylinder.

129. Motor vehicle according to claim 128 characterised in that this snifting opening is formed as a snifting bore or several snifting bores in the cylinder wall of this cylinder.

130. Motor vehicle according to claim 129 characterised in that this snifting bore has a substantially circular round cross-section.

131. Motor vehicle according to at least one of claims 128 to 130 characterised in that the extension of the piston in the cylinder in the longitudinal direction of the cylinder is greater than the longitudinal extension of the snifting opening in the longitudinal direction of the cylinder.

132. Motor vehicle according to claim 131 characterised in that this piston has a seal.

133. Motor vehicle according to at least one of claims 128 to 132 characterised in that this piston can occupy at least two position areas, namely a first normal operating position area in which no flow connection is provided between this fluid compensating container, this connecting device and this kinetic device, and a snifting position area in which this snifting opening is opened, and a flow connection exists between this fluid compensating container, this snifting channel, the snifting opening, this connecting device and this kinetic device.

134. Method according to claim 133 characterised in that this piston can furthermore occupy a position area in which this snifting opening is completely closed.

135. Motor vehicle according to at least one of claims 99 to 134 characterised in that this drive device has an element which changes its state in dependence on the actual state of this pressure generating device.

136. Motor vehicle according to claim 135 characterised in that this element is a gearbox element.

137. Motor vehicle according to claim 135 or 136 characterised in that this element is a shift device of a gearbox.

138. Motor vehicle according to at least one of claims 135 to 137 characterised in that this element is an element which influences the translation ratio of a gearbox with infinitely variable translation.

139. Motor vehicle according to at least one of claims 135 to 138 characterised in that this drive device of this motor vehicle has a clutch device and that this kinetic device influences the clutch device.

140. Motor vehicle according to claim 139 characterised in that this motor vehicle has an automatic clutch and that this kinetic device influences the state of this automatic clutch.

141. Motor vehicle according to claim 139 or 140 characterised in that this kinetic device operates the disengagement mechanism of this clutch device.

142. Motor vehicle according to at least one of claims 139 to 141 characterised in that this clutch device involves a single-disc dry clutch.

143. Motor vehicle according to at least one of claims 133 to 141 characterised in that this normal operating position area is an area in which the torque transfer of this clutch is controlled.

144. Motor vehicle according to at least one of claims 133 to 142 characterised in that this clutch device has an adaption device through which the transfer of a torque dependent on the operating values is guaranteed.

145. Motor vehicle according to at least one of claims 139 to 144 characterised in that the position of the piston in the cylinder of the pressure generating device corresponds substantially to a predetermined position of the disengagement device of a clutch.

146. Motor vehicle according to at least one of claims 102 to 145 characterised in that a clutch control device is provided which issues control commands to this pressure generating control device in order to control this clutch.

147. Motor vehicle according to claim 146 characterised in that this pressure generating control device is integrated in this clutch control device.

148. Motor vehicle according to at least one of claims 102 to 147 characterised in that at least a further control device is provided which controls at least one function relevant to this drive device and that this pressure generating control device interacts with this control device.

149. Motor vehicle according to at least one of claims 146 to 148 characterised in that this pressure generating control device is integrated in this second control device.

150. Motor vehicle according to at least one of claims 140 to 149 characterised in that this pressure generating control device is controlled through a program stored in a memory and that this program has at least a first program section which controls a learning mode of the pressure generating control device and at least a second program section which controls the normal operation of this pressure generating control device.

151. Motor vehicle according to claim 150 characterised in

that this first program section causes control commands to be sent to this movement device in order to bring the displacement element of this pressure generating device into predetermined positions and that in these predetermined positions is stored the signal of this sensor device which detects the position of this displacement element and at least one signal of a second sensor device which has at least one sensor which detects a physical value which is changed during displacement of this displacement element in this pressure generating device, and that the pressure generating control device with this program on the basis of this information determines the position of this snifting opening with a predetermined accuracy, and that furthermore at least one data memory device is provided in order to store the detected data for the position of the snifting opening.

152. Motor vehicle according to claim 151 characterised in that this second sensor is a pressure sensor.

153. Motor vehicle according to claim 152 characterised in that this pressure sensor is mounted so that it detects the pressure in this snifting channel.

154. Motor vehicle according to claim 152 characterised in that this pressure sensor is arranged so that it detects the pressure at at least one point inside this system section.

155. Motor vehicle according to at least one of claims 149 to 154 characterised in that an input device is provided through which the pressure generating control device can be changed over to the learning mode.

156. Motor vehicle according to at least one of claims 102 to 155 characterised in that an electrical connecting device is provided through which this pressure generating control

device can be connected with an external computer unit.

157. Motor vehicle with a drive unit which has at least one kinetic device operated by a fluid substantially as herein described with reference to the accompanying drawings.

158. A method for operating a motor vehicle substantially as herein described with reference to the accompanying drawings.

The Patent Office

60

Application No:	GB 9717133.4	**Examiner:**	Mike McKinney
Claims searched:	1 to 158	**Date of search:**	28 January 1998

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Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): F2L (LK)

Int Cl (Ed.6): F16D 48/02, 48/06, 27/00, 29/00.

Other: ONLINE: WPI; EDOC.

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X.E	GB 2314136 A	(VALEO) see figs.	1 and 99 at least.
X,E	GB 2310473 A	(LUK) see figs 1 to 3 and lines 26 to 19 page 11.	1 and 99 at least.
X	GB 2233723 A	(FICHTEL & SACHS) see fig and lines 2 to 7 page 8.	1 and 99 at least.
X	GB 0571432	(TARLTON) see fig 1 and lines 107 to 109 page 3.	1 and 99 at least.
X	GB 0547465	(ROVER) see fig and lines 10 to 12 page 3.	1 and 99 at least.
X	US 5094079	(LEIGH-MONSTEVENS et al) see fig 1 and line 62 col 3 to line 2 col 4.	1 and 99 at least.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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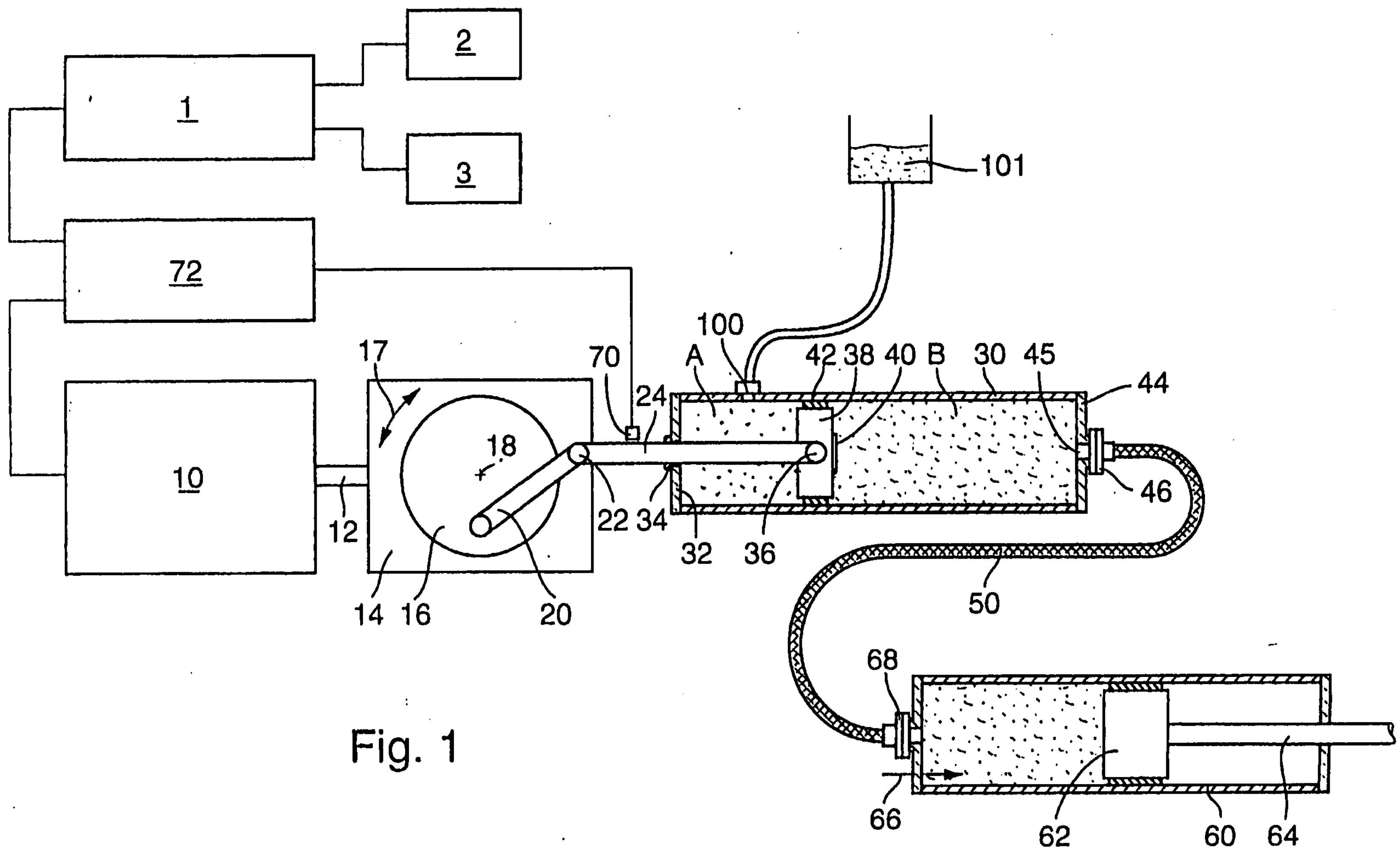
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Fig. 1

Fig. 2

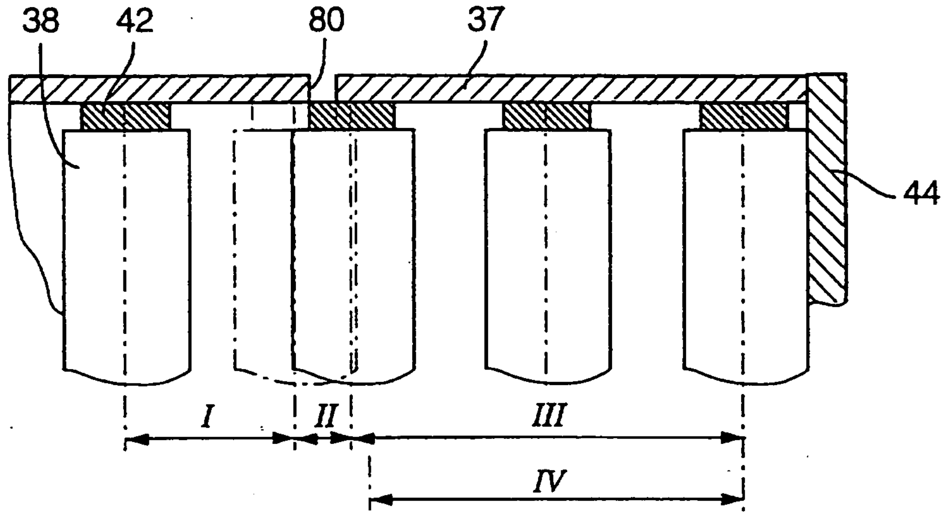

Fig. 3